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This invention relates to a structurally improved injection device and especially a unit by means of which medicament may be hypodermically injected without the use of a needle through the skin into the underlying  
5 tissues.

It is an object of the invention to furnish a mechanism by means of which - without reloading - a successive series of injections may be made; each such injection presenting according to the discretion of the  
10 physician or operator an adequate volume of medicament.

Thus, a single injection may be made where a number of successive injections have heretofore been necessary to distribute into the tissue a desired volume of medicament. Also, the volume of these single injections  
15 may be increased at will by constructing mechanisms embodying the teachings of the present invention.

A further object is that of furnishing an apparatus in which the medicament - during discharge - will be maintained under substantially constant and even pressure  
20 and will accordingly flow with constant velocity. Therefore, the physician or other operator may be assured that substantially the entire predetermined medicament dosage has been so injected rather than having a portion of the dosage disbursed over the surface of the skin.

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Still another object is that of furnishing an apparatus of this type which will be light in weight, compact and readily portable and capable of manipulation by the operator. Additionally, when it becomes necessary  
5 to recharge or refill the unit, this may be done with minimum effort and in a short interval of time.

With these and other objects in mind, reference is had to the attached sheets of drawings illustrating practical embodiments of the invention and in which:  
10 Fig. 1 is a side elevation of one form of injector;  
Fig. 2 is a longitudinal section of the same;  
Figs. 3 and 4 are transverse sectional views taken respectively along the lines 3-3 and 4-4 and in the direction of the arrows as indicated in Fig. 2;  
15 Fig. 5 is a fragmentary sectional side view of a portion of a unit showing an alternative form of structure;  
Fig. 6 is a transverse sectional view taken along the lines 6-6 and in the direction of the arrows as indicated in Fig. 5;  
20 Fig. 7 is a view similar to Fig. 1 but showing a still further form of unit;  
Fig. 8 is a sectional side view of the apparatus as shown in Fig. 7;  
Fig. 9 is a transverse sectional view taken along  
25 the lines 9-9 and in the direction of the arrows as indicated in Fig. 8;  
Fig. 10 is a side elevation of one of the inner members of the apparatus as shown in Fig. 8;

Fig. 11 is an enlarged fragmentary and sectional view through that portion of the unit containing the valve mechanism; and

5 Fig. 12 is a sectional view taken along the lines 12-12 and in the direction of the arrows as indicated in Fig. 11.

It is proposed according to the preferred embodiments of the invention to employ a compressed gas as a motive force. That gas may conveniently be CO<sub>2</sub>. As is  
10 apparent other gases might also be employed and in certain instances, different motive force than gas under pressure might be utilized. Therefore, except where otherwise indicated in the appended claims, this feature of the present invention is to be taken in an illustrative rather  
15 than in a limiting sense.

Thus, in these views, the numeral 15 indicates a body which mounts a cap member 16. Disposed within the latter is a flask 17 of more or less conventional construction and which has an initially sealed neck portion  
20 18 capable of being perforated by a cannula 19 to afford access to the interior of the flask. Adjacent its upper end the body is formed with a threaded flange for mounting

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the cap 16. The latter having screw threads 20 cooperating with corresponding threads forming a part of body 15, it becomes feasible by tightening the cap to press the flask 17 inwardly. Such pressure obviously causes the pointed end of cannula 19 to penetrate the sealing material 18 in the neck of the flask. When the cannula has once cleared this sealing material, then the gas under pressure within the flask may flow through the bore of the cannula to other portions of the apparatus.

Communicating with the bore of cannula 19 is passage 21. This passage continues in the form of a passage 22 communicating with the upper end of a cylinder 23 formed in the body 10. Within this cylinder, a piston 24 may be disposed. A stem or rod 25 is fixed to or forms a part of the piston and extends within the main bore 26 of body 10.

Interposed between passages 21 and 22 is a valve mechanism. This mechanism may take one of several different forms. However, in addition to controlling the flow of gas under pressure from the flask 17 or other source to the cylinder, the mechanism should be of such type that it will provide an effective seal, allowing of such flow and substantially completely interrupting the flow at the will of the operator. Also, while in certain instances

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it may be unnecessary or even undesirable to relieve the pressure within cylinder 23, it would ordinarily be advantageous to assure of a diminution of pressure above the piston when subsequent manipulations of the mechanism are attempted. Therefore, the valve mechanism which is contemplated as a part of the present device in addition to including a readily controlled structure permitting of gas flow and interruption of gas flow, should also contemplate a structure such that pressures within the cylinder should be capable of being relieved. Having in mind that the ordinary physician or technician may not be especially adept in mechanical manipulation, such relief should occur substantially automatically.

Thus, as especially shown in Figs. 11 and 12, transverse passages 27 and 28 may be formed in the body 10 and connected with passages 21 and 22. These transverse passages may be connected by an axially extending passage portion 29. Within passage 27, a spring-pressed valve 30 may be disposed. From this valve an actuator 31 may extend through and beyond the exterior face of body 10. A packing assembly 32 may prevent a substantial escape of gas past the face of the actuator or stem 31. Likewise, the rear end of passage 27 may be closed as indicated at 33 to prevent any substantial escape of fluid under pressure. As will also be seen, the diameters of passage

27 and actuator or stem 31 are such that with the valve in unseated position, an adequate space is present for the flow of gas under pressure.

Transverse passage 28 is also provided with a  
5 valve seat with which a valve 34 is cooperable; it being noted that one end of this passage extends through the exterior of the body 10 and is left unobstructed so that gas may vent through the same. The spring-pressed valve 34 is also provided with a stem or actuator 35. This element  
10 preferably passes through the bore of a packing and sealing assembly generally indicated at 36. Its outer end may conveniently terminate in a slotted portion 37. Accordingly, it is obvious that an inward pressure on the stem 31 will cause a shifting of the valve 30 to unseated position  
15 while an outward pull on the actuator 35 will unseat valve 34.

To secure such shifting, the body 10 or an associated part may carry a pivotally mounted handle 38. This handle is urged in an outward direction by, for example,  
20 a spring 39. A flattened or contact portion 40 of the handle may be disposed in line with the outer end of the actuating stem 31. A pin 41 carried by handle 38 may ride within the slotted portion 37 of actuator 35. It follows

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that when handle 38 is swung inwardly against the resistance offered by spring 39, valve 34 will be shifted to closed position incident to the action of the spring associated therewith. Continued movement on the part of handle 38 will cause portion 40 of the same to exert an axial thrust against the end of stem 31. Therefore, valve 30 will be shifted to open position. When the pressure on handle 38 is relieved, the latter under the influence of spring 39 will move outwardly or in a counter-clockwise direction as viewed in Fig. 11. With such movement, valve 30 will initially shift to closed position under the action of the spring cooperating therewith. As the handle shifts to its limit of movement, pin 41 will engage the end of slot 37 to exert a pull on stem 35. The valve of spring 39 being in excess of the value of the spring cooperating with valve 34, it follows that the latter spring will be compressed and valve 34 will move to unseated position. As will also be apparent from a consideration of this structure, gas under pressure will normally tend to seat valves 30 and 34. This action in itself may - in certain instances - make it unnecessary to employ springs normally urging these valves to seated positions. However, ordinarily it is preferred that the springs be utilized in order to assure a rapid seating of the valves and the consequent avoidance of wastage of the gas under pressure flowing from flask 17 or other source.

Now considering the structure as especially shown in Figs. 1 to 5, it will be noted that the stem 25 may carry a series of abutments 42. These may actually be in the nature of pins or rods extending through the  
5 plunger 25 and arranged in the form of a spiral series. While in the embodiment under consideration only five pair of these abutments have been illustrated, it is to be understood that a greater or lesser number might be employed. Rotatably mounted and concentrically disposed with respect  
10 to plunger 25, at a point below the abutments 42, is a ring-shaped member 43. The latter may be formed with a series of indentations 44 in its exterior face and corresponding to the number of abutments 42 employed. A spring-pressed detent member 45 may cooperate with these indenta-  
15 tions. Expansible rings 46 may be employed to extend into grooves formed in the adjacent faces of ring 43 and the channel of body 10 which receives the same. As especially shown in Fig. 4, the outer face of ring member 43 may be exposed upon and extend beyond a slot formed in the wall  
20 of body 10. This slot may extend throughout substantially 180°. As in Fig. 2, screws or pins 47 may be carried by the ring at this point and ride within the grooves formed in the body of the unit and its lower portion and which grooves also accommodate the expansible springs 46.



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The ring 43, as shown in Fig. 4, may carry inwardly extending projections or abutments 48. These are conveniently opposed to each other and their upper surfaces are capable of cooperating with the outer ends of a pair of abutments 42 (Fig. 2) which lie in the same plane. Finally, with respect to this portion of the apparatus, will be noted as in Fig. 1, that a scale indicated at 49 may appear upon the exterior face of body 10. This scale may register with a suitable graduation upon the exterior face of ring 43. Having in mind that the embodiment herewith described includes five pair of abutments, the graduations of the scale 49 may also include five divisions.

Preferably, the lower end of the unit will provide a medicament-receiving chamber or space. According to a preferred concept of the invention, the medicament will be contained within an ampule. This ampule may take one of numerous different forms. As illustrated the lower portion of the unit indicated by the reference numeral 51 provides a chamber which receives an ampule comprising a body 51. The upper end of this body is closed by a stopper or sealing member 52 capable of acting as a piston. The bore of body 51 has a diameter such that it may receive the lower end of plunger 25 which may thus bear against and move stopper 52. The lower end of the ampule or cartridge

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51 is preferably also sealed by a stopper 53. That stopper in common with the stopper 52, may be formed of rubber or similar material. It will be piercible by a cannula 54 having a pointed upper end and mounted by a cap 55. This cap is connected by screw threads, with corresponding threads formed on the outer lower end of portion 50. The bore of the cannula continues in the form of a passage 56 which has a restricted outer end such that a minute cross sectional area is presented. As is apparent, this passage may actually be formed by the bore of the cannula 54. Adjacent its outer or discharge end, cap 55 may be formed with a sealing flange or projection 57. The space between the inner face of the cap and the outer end of the plunger 25, will be just sufficient to permit of the insertion of a medicament-containing ampule or cartridge into the chamber of portion 50. Thereupon, cap 55 may be reapplied. In such reapplication, it is apparent that the upper face of stopper 52 or equivalent sealing member will move into engagement with the outer end of plunger 25 while the cannula 54 will pierce stopper 53 and be immersed within the body of the medicament. With such immersion and tightening of the parts, it is apparent that any air within bore

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56 will be discharged and that bore will be filled with liquid medicament.

With a flask 17 in position as afore described, it will be understood that the apparatus is ready for use.

5 Assuming that a physician desires for example to inject one cubic centimeter of medicament, the sealing portion 57 or other outer end surface of the cap or its equivalent is brought into contact with the skin of the patient at a point overlying that at which the injection is to be  
10 made. Prior to such application of the device, the ring 43 is turned so that the abutments or projections 48 of the same are in line with the lower or outermost pair of projections 42 on plunger 25. In such turning, no rotation of the plunger will occur because the latter may be formed  
15 with a groove 58 which is engaged by an inwardly extending projection 59 conveniently forming a part of the end portion 50. With the valve mechanism operating, it is apparent that gas under pressure is admitted into cylinder 23 resulting in a projection of piston 24. Such projection,  
20 will cause the lower end of plunger 25 to bear against the stopper or piston portion 52 and to shift the latter. With such shifting, the medicament within body 51 will be expressed through the bore of cannula 54. This discharge will obviously occur under high velocity and pressure.  
25 With the discharge end of bore 56 having sufficiently fine

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cross section, not alone will the velocity of flow be increased but also the stream of medicament will have such a minute transverse area that it will penetrate the epidermis without substantial pain to the patient or injury to the skin.

5           Considering the operation of the valve mechanism, especially shown in Figs. 11 and 12, it will be understood that as afore brought out a shifting of the handle 38 seats the valve 34 and unseats the valve 30. Accordingly, the gas may flow from the bore of cannula 19 through passages 21,  
10   27, 29, 28 and 22 into the cylinder. This will produce the desired piston projection. With the release of handle 38, valve 30 will seat to seal against discharge of further gas. Accordingly, the gas under pressure within flask 17 or its equivalent will be guarded against leaking and a single  
15   flask may be employed for a number of successive injections without it being necessary to renew the flask. The release of the handle 38 allows valve 34 to move to unseated position. With such movement, gas under pressure within cylinder 23 may flow backwardly through passage 22 and into transverse  
20   passage 28 to be vented to the atmosphere through the unobstructed end of the latter. It is generally preferred to relieve the pressure within the cylinder after each injection. By such relief, the operator may without difficulty adjust the parts of the apparatus to permit of further injection.  
25   As will be appreciated, the valve mechanism has been somewhat schematically illustrated in order that the operation of the same may be clearly understood. In actual practice it is preferred that "needle" valves be employed at 30 and 34. These should cooperate with "line-seals" in order to

assure a proper seating of the parts. By such constructions, the valves may be shifted to seated and unseated positions with minimum effort; the diameter of the valves having been somewhat exaggerated in the figures of question. Also, the  
5 actuating mechanism may be redesigned so that the valves may be shifted to seated and unseated positions by a structure of simple design.

Ordinarily, a successive injection may again involve only the discharge of one cubic centimeter of  
10 medicament through the epidermis into the underlying tissues. In that event, the indicating mark upon ring 43 will be shifted to align with the second graduation of scale 49. This will bring the abutments or projections 48 of the ring into registry with the second pair of abut-  
15 ments or projections 42 of the plunger 25. Thereupon, by repeating the afore described sequent of operation, the plunger may be again projected to inject the desired quantity of medicament. Further injection will be interrupted when the pair of projections 42 come into contact with the  
20 projections or abutments 48.

If it is desired to inject two, three or more cubic centimeters in a single operation, then the indicating mark on ring 43 may be shifted to align with the proper graduation of scale 49. With such rotation of the ring,  
25 the pair of projections or abutments 48 will be aligned

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with that pair of projections 42 on the plunger 25 which are spaced from the projections 48 a distance corresponding to the value of the injection to be given. Thereupon, by operating the valve mechanism, the injection may be completed. As is apparent with the pressure within the cylinder relieved as afore brought out, the ring may readily be shifted without it being necessary to overcome undue frictional contact between the outer surfaces of a pair of projections 42 and the upper or inner surfaces of the projections 48. More important, with such relief or venting of pressure, the plunger 25 will not tend to shift outwardly as the ring is adjusted to the desired position. Accordingly, the medicament will not be accidentally discharged from the orifice of bore 56.

The same result may be achieved by the alternative ring structure shown in Figs. 5 and 6. In these views, the numeral 60 indicates the upper portion of the unit and 61 the lower part of the same. These portions correspond to the parts generally heretofore indicated by the reference numerals 15 and 50 respectively. The adjacent ends of these parts are screw threaded and connected by a threaded collar 62. As especially shown in Fig. 6, this collar may be conveniently slotted through 180° as indicated at 63. Mounted between the adjacent end edges of parts 60 and 61 is a ring 64. The latter mounts opposed abutments or stop portions 65. These are

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capable of being selectively engaged by one of the pairs of abutments or projections 42 carried by the plunger 25.

5 The face of the collar 62 adjacent the slot 63 is conveniently formed with a scale (not shown). This scale may register with a projection forming a part of actuator 66 secured to ring 64. The graduations may be substantially identical with those heretofore indicated by the numeral 49. It is obvious that as ring 64 is adjusted to various positions, its abutments or stop  
10 portions 65 will register with one or another of the stop portions 42 carried by the plunger. Therefore, upon the plunger being projected, engagement will occur between those abutments 42 which are aligned with the abutments or stops 55. Consequently, the movements of the parts  
15 will be arrested and only a desired quantity of medicament will be expressed.

The same result as is achieved in the foregoing figures, is also capable of accomplishment by the structure shown in Figs. 7 to 10 inclusive. In fact, in  
20 certain instances, that structure might be preferred to the ones heretofore described. In these latter views, the numeral 66 indicates the casing of the device to the upper end of which a cap 67 may be applied; that cap conveniently enclosing and actuating a flask 68 containing

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a compressed gas. Body 66 is hollow and presents a cylinder chamber as heretofore described. Also, a suitable valve mechanism is interposed between the cylinder and the discharge end of the flask. Moreover, the lower  
5 end of body 66 provides a medicament-containing chamber which may have its lower end closed by a cap 69. This cap conveniently provides the orifice through which the fine stream of medicament is discharged at high velocities. As heretofore brought out, it is in many instances pre-  
10 ferred that an ampule be disposed within this chamber and that the ampule 70 embody a construction such that pressure upon its upper end results in the expressing of the medicament. However, it is again to be understood that alternative structures of substantially different  
15 design may be employed.

The inner face of body 66 is formed with a spirally extending groove 71. This groove conveniently extends throughout two complete convolutions. Disposed within the bore of body 66 and below the cylinder of the  
20 same is a sleeve member 72. This member has a thread or spirally extending abutment 73 on its outer face and preferably adjacent its upper end. As illustrated, this abutment extends throughout one complete convolution. It is to be understood that while for purposes of strength



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it is preferred that the thread extend throughout an entire convolution, this need not necessarily be so. In the event that thread 73 is shortened, the length of the thread or channel 71 might be diminished.

- 5           The lower portion of sleeve 72 may present on its outer face a series of indicating marks running for example from 1 to 10 inclusive. These have been indicated by the reference numeral 74. Body 66 is formed with an opening 75 within the zone of the indicia 74.
- 10   The numerals or other scale marks will be visible through this window. Between the thread 73 and the surface presenting the indicia 74, the sleeve 72 is formed with an annular series of gear teeth 76. These preferably have a length slightly in excess of the overall stroke of
- 15   the plunger 77. That stroke - as will be understood - is substantially equal to the overall length of medicament - containing chamber. Teeth 76 are engaged by the teeth of a gear 78 mounted for rotation by and extending beyond the outer face of body 66. Thus, it is apparent that
- 20   as actuator 78 is rotated, sleeve 72 will be turned. This will result in an axial shifting of the sleeve within body 66. The upper edge portion of this sleeve is of a diameter such that it provides a stop for a shoulder

or enlarged portion 79 forming a part of plunger 77.

In order to prevent an accidental turning of the sleeve, a catch or restraining element 80 may be employed. Thus, when an axial thrust is exerted upon the sleeve, the  
5 thread 73 will not ride within the groove 71 resulting in an improper operation of the parts. Of course, if desired, the grooves 71 and thread 73 might be pitched to a lesser extent. This could be achieved by having the groove 71 extend through more than one convolution; in-  
10 cluding for example two or three convolutions. Likewise, the ampule or medicament-receiving chamber could be made of larger diameter and less length so that the thread would not have to be pitched so steeply. Moreover, by having the teeth 76 of a type such that a worm wheel,  
15 rather than the gear 78, cooperates, accidental rotation of the parts can be prevented.

In any event, with the sleeve 72 in position within the body 66, it will be assumed that the medicament-containing chamber is filled and the cap 69 is in  
20 position, if such a cap be employed. It will moreover be assumed that a flask 68 has been punctured as afore described and that therefore, motive pressure is available. Under these circumstances, sleeve 72 will be in a position where the numeral 1 is visible through  
25 window 75. This will be true, conceding for example that only one cubic centimeter is to be injected. Under such circumstances, the upper edge of sleeve 72 will be spaced from the adjacent edge of the

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plunger enlargement 79 a corresponding distance. If with the apparatus properly disposed with respect to tissue which is to be injected the valve mechanism is now operated, then plunger 77 will be forced downwardly to express the  
5 desired amount of medicament. With the completion of the injection, enlargement 79 will engage the upper edge of sleeve 72. These parts thus function as a stop to arrest movement of the plunger and expression of medicament at a point where precisely the desired amount of the latter has  
10 been injected. If a larger dosage is to be injected, then sleeve 72 may be rotated so that its upper edge is spaced a greater distance from enlargement 79 or other arresting portion of the plunger. In this connection, it is apparent that if the ampule or the medicament-containing chamber  
15 have for example a capacity of ten cubic centimeters, then not alone may individual and successive doses of any desired value be injected but up to the entire capacity of the unit may be so injected in a single operation. All that will be necessary to effect this result will be for the physician  
20 or other operator to rotate the sleeve and axially move it to the desired extent. In this connection, it will be understood that any desired alternative mechanism might be ~~understood that any desired alternative mechanism might be~~ employed for effecting such rotation.

25 Thus, among others, the several objects of the invention as afore described are achieved. Obviously numerous changes in construction and rearrangement of the parts might be resorted to without departing from the spirit of the invention as defined by the claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1) A device for the hypodermic injection of liquid medicament at skin-penetrating velocities without the use of a piercing needle, said device comprising a body formed with a medicament-receiving chamber, a plunger movable with respect to said body and acting upon the medicament within said chamber to expel the same; the range of movement of said plunger being such that substantially all of the medicament within said chamber may be expelled in a single plunger movement, a member having threaded connection with said body and said member providing a stop arresting plunger movement at points short of the limit of its range of movement.

2) A device for the hypodermic injection of liquid medicament at skin-penetrating velocities without the use of a piercing needle, said device comprising a body formed with a medicament-receiving chamber, a plunger movable with respect to said body and acting upon the medicament within said chamber to expel the same; the range of movement of said plunger being such that substantially all of the medicament within said chamber may be expelled in a single plunger movement, a sleeve rotatably mounted with respect to said body and having threaded connection therewith, said sleeve providing a stop to arrest plunger movement at points short of the limit of its range of movement and means for rotating said sleeve with respect to said body.

3) A device for the hypodermic injection of liquid medicament at skin-penetrating velocities without the use of a piercing needle, said device comprising a body formed with a medicament-receiving chamber, a plunger movable with respect to said body and acting upon the medicament within said chamber to expel the same; the range of movement of said plunger being such that substantially all of the medicament within said chamber may be expelled in a single plunger movement, a sleeve rotatably mounted with respect to said body and having threaded connection therewith, said sleeve providing a stop to arrest plunger movement at points short of the limit of its range of movement, means for rotating said sleeve with respect to said body and means for indicating the position to which said sleeve has been shifted.

4) A device for the hypodermic injection of liquid medicament at skin-penetrating velocities without the use of a piercing needle, said device comprising a body formed with a medicament-receiving chamber, a plunger movable with respect to said body and acting upon the medicament within said chamber to expel the same; the range of movement of said plunger being such that substantially all of the medicament within said chamber may be expelled in a single plunger movement, a sleeve rotatably mounted with respect to said body and having threaded connection therewith, said sleeve providing a stop to arrest plunger movement at points short of the limit of its range of movement, means for rotating said sleeve with respect to said

body, a scale disposed upon the face of said sleeve and said body being formed with an opening through which the elements of said scale are visible.

5) A pressure-creating device for injecting medicament at velocities such that they will penetrate the skin without the use of a piercing needle, said device including a body formed with a medicament chamber having an outlet of reduced cross section, power means which upon full projection into said chamber will displace substantially all medicament therefrom, means mounted for rotation within said body and cooperative with said power means for arresting the projection of the latter at a point short of its being fully projected, control means rotatably mounted by and extending beyond said body and means for connecting said control means with said arresting means for causing the latter to limit the projection of the power means at pre-determined points.

6) A pressure-creating device for injecting medicament at velocities such that they will penetrate the skin without the use of a piercing needle, said device including a body formed with a medicament chamber having an outlet of reduced cross section, power means which upon full projection into said chamber will displace substantially all medicament therefrom, means providing movement-limiting surfaces projecting from and shiftable with said power means, means mounted for movement within said body and extending into the path of travel of said surfaces to arrest the projection of said power means at a point short of its being fully projected and movable control means extending exteriorly of said body and operatively connected to said arresting means for shifting the latter.

7) A pressure-creating device for injecting medicament at velocities such that they will penetrate the skin without the use of a piercing needle, said device including a body formed with a cylinder adjacent one end and a medicament chamber at the opposite end, said chamber having an outlet of reduced cross section, a piston shiftable within said cylinder in response to the introduction of fluid under pressure into the same, a stem connected to move with said piston and fully projectible into said chamber to displace substantially all medicament therefrom, control means rotatable within said body and encircling said stem and said control means providing surfaces extending into the path of travel of parts associated with said stem for arresting movement of the latter at a point short of its fully projected position.

8) A pressure-creating device for injecting medicament at velocities such that they will penetrate the skin without the use of a piercing needle, said device including a body formed with a cylinder adjacent one end and a medicament chamber at the opposite end, said chamber having an outlet of reduced cross section, a piston shiftable within said cylinder in response to the introduction of fluid under pressure into the same, a stem connected to move with said piston and fully projectible into said chamber to displace substantially all medicament therefrom, control means rotatable within said body and encircling said stem, said control means providing surfaces extending into the path of travel of parts associated with said stem for arresting movement of the latter at a point short of its fully projected position, and means mounted by and extending exteriorly of said body to shift said control means.

9) A pressure-creating device for injecting medicament at velocities such that they will penetrate the skin without the use of a piercing needle, said device including a body formed with a cylinder adjacent one end and a medicament chamber at the opposite end, said chamber having an outlet of reduced cross section, a piston shiftable within said cylinder in response to the introduction of fluid under pressure into the same, a stem connected to move with said piston and fully projectible into said chamber to displace substantially all medicament therefrom, control means rotatable within said body and encircling said stem, said control means providing surfaces extending into the path of travel of parts associated with said stem for arresting movement of the latter at a point short of its fully projected position, and means visible exteriorly of said body for indicating the position of said control means and accordingly the point at which the movement of said stem will be arrested.

10) An injection device for medicament comprising a body formed with a cylinder to receive fluid under pressure, a piston movable within said cylinder, said body being formed with a medicament-receiving chamber from which medicament is to be ejected, a plunger extending between said piston and chamber and acting in response to movement of the former to eject medicament from the latter, a sleeve rotatable within said body and presenting surfaces acting to arrest the movement of said piston, a spirally extending cooperating rib and groove structure forming a part of said body and sleeve whereby upon relative rotations being effected between the sleeve and body the sleeve and its arresting surfaces will be shifted axially of the body and means extending beyond the outer face of the body for effecting such rotation.

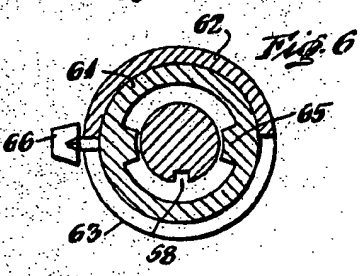
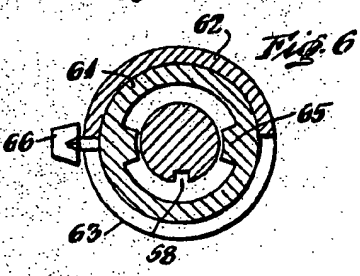
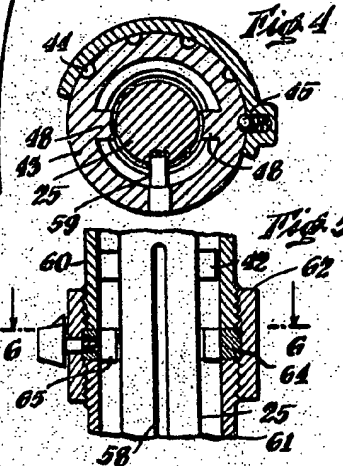
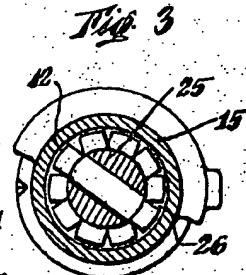
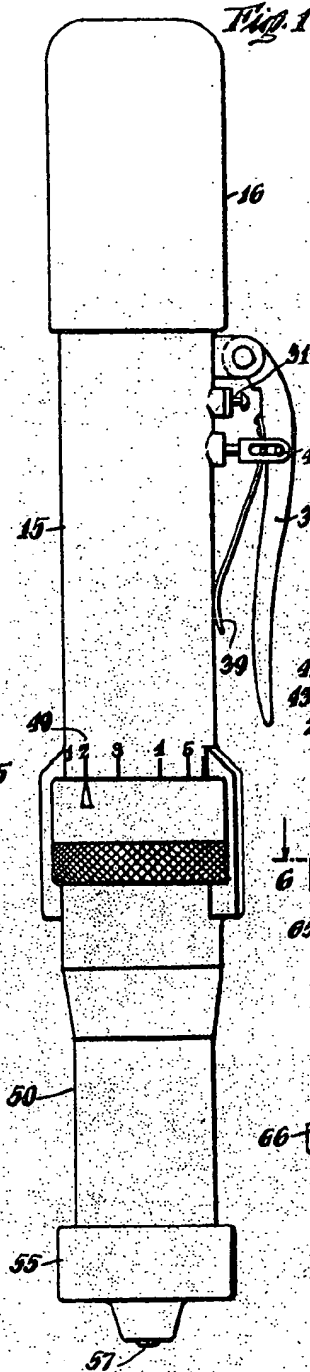
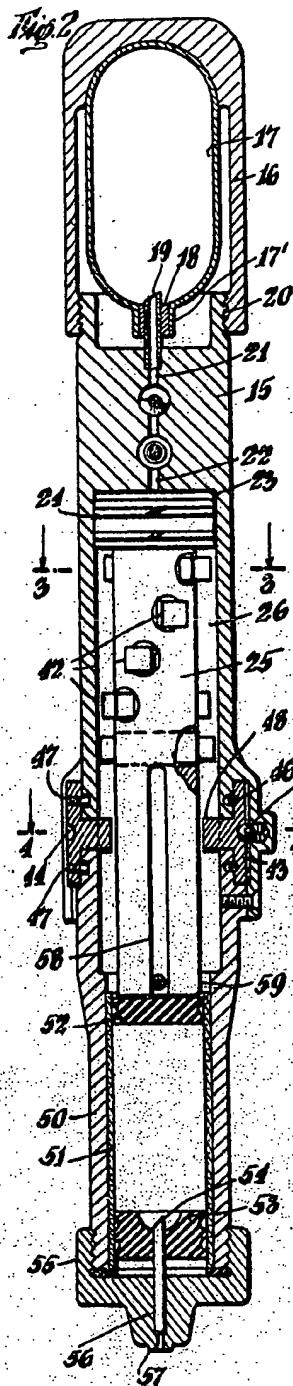


11) A pressure-creating device for injecting medicament at velocities such that they will penetrate the skin without the use of a piercing needle, said device including a body formed with a medicament chamber having an outlet of reduced cross section, power means which upon full projection into said chamber will displace substantially all medicament therefrom, a series of abutments extending from said power means and laterally displaced with respect to each other and stop means movably carried by said body and selectively engagable by one of said abutments to arrest movement of said power means at a point short of its full projection.

12) A pressure-creating device for injecting medicament at velocities such that they will penetrate the skin without the use of a piercing needle, said device including a body formed with a medicament chamber having an outlet of reduced cross section, power means which upon full projection into said chamber will displace substantially all medicament therefrom, a series of abutments extending from said power means and laterally displaced with respect to each other, a further abutment and means movably mounted by said body and carrying said further abutment to shift the latter whereby said abutment may be selectively contacted by one of said series of abutments to arrest movements of the power means.

13) A pressure-creating device for injecting medicament at velocities such that they will penetrate the skin without the use of a piercing needle, said device including a body formed with a medicament chamber having an outlet of reduced cross section, power means which upon full projection into said chamber will displace substantially all medicament therefrom, a series of abutments extending from said power means and laterally displaced with respect to each other, a further abutment, means movably mounted by said body and carrying said further abutment to shift the latter whereby said abutment may be selectively contacted by one of said series of abutments to arrest movements of the power means and means for confining such latter movements to a substantially axial path.

14) A pressure-creating device for injecting medicament at velocities such that they will penetrate the skin without the use of a piercing needle, said device including a body formed with a medicament chamber having an outlet of reduced cross section, power means which upon full projection into said chamber will displace substantially all medicament therefrom, a spirally arranged series of abutments extending from said power means, a ring-shaped member disposed in line with a slot extending circumferentially of said body, an inwardly extending abutment mounted by said member and said member being rotatable with respect to said body to shift said latter abutment into the path of travel of one of the first-named abutments.



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Attorney Nov. 3, 1948

INVENTOR

J. N. Smoot

Marked Clerk  
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Fig. 7



Fig. 8

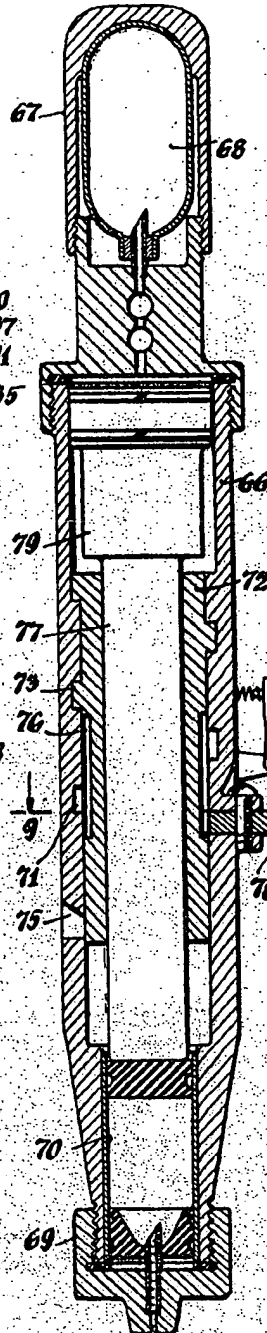


Fig. 9

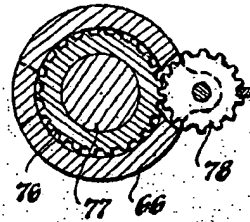
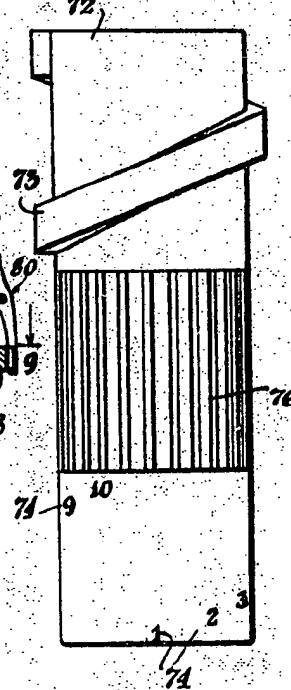


Fig. 10



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Fig. 11

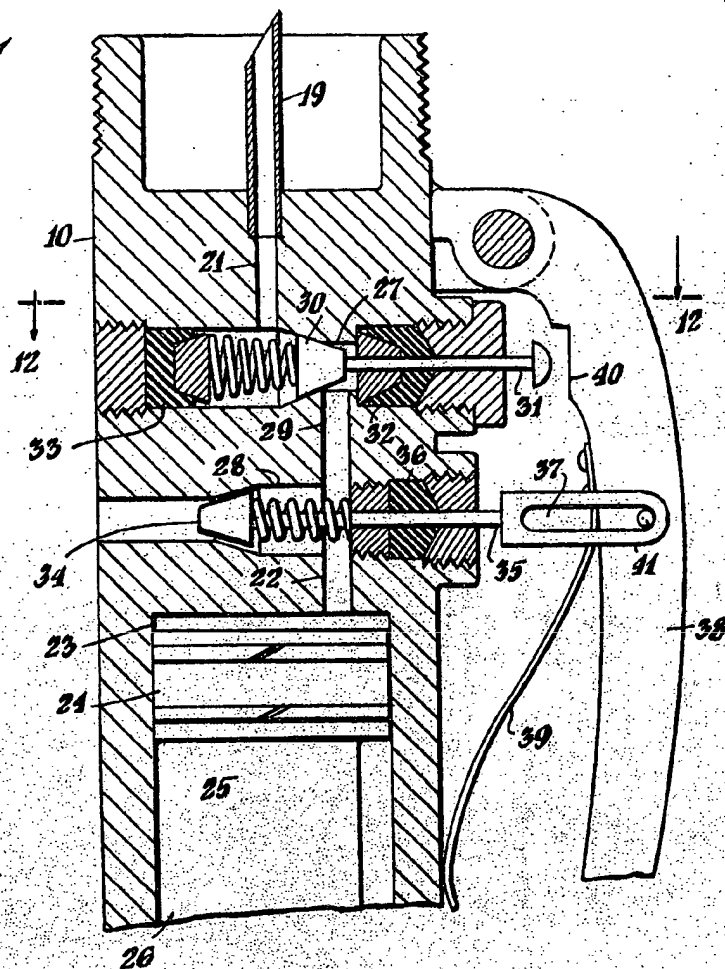
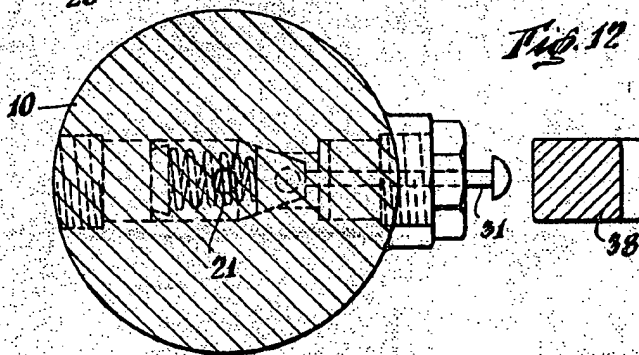


Fig. 12



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Mark & Clark  
Attorneys

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